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of stimuli *Paramecium* responds with the same motor reaction, in greater or less intensity. The direction of motion after a stimulus is determined by the structure of the animal's body and has no relation to the localization of the stimulus. *Paramecia* are not directly attracted by any agent; they collect in the regions of certain conditions merely in virtue of the fact that these conditions cause no motor reactions, while the surrounding fluid causes a motor reaction that results in random movements, which must (through the laws of chance) eventually bring the animal into a region where these motors cease.

Phototaxis of Daphnia. C. B. DAVENPORT and F. T. LEWIS.

THE problem is to determine the dependence of the degree of phototactic sensitiveness upon preceding conditions of illumination. Other conditions being similar, do *Daphnia* reared in the dark respond to a fainter illumination than those reared in the light? Special apparatus afforded a quantitative answer to this question. *Daphnia* reared in half-darkness moved, on the average, nearly three times as far toward a light of about minimal intensity as did *Daphnia* reared in the light. We may conclude: Those individuals reared in the dark have become attuned to a lower intensity than those reared in the light.

The minimum intensity inducing phototaxis was, in the more sensitive *Daphnia*, 0.002 candle power at a distance of 3.5 meters, or $\frac{0.002}{3.5^2} = 0.00016$ meter candles.

The phototropic sensitiveness of *Daphnia* is quite equal to the phototropic sensitiveness of the most sensitive seedlings.

Early Development of Pennaria Tiarella. CHAS. W. HARGITT.

THE egg of *Pennaria* is of relatively large size and heavily yolk-laden. In color it is of a light orange or pinkish hue. It is

of ectodermal origin and grows by an active absorption of other ovarian cells. The egg is discharged almost immediately upon the liberation of the medusa, which takes place during the evening from seven to ten o'clock. Fertilization occurs very soon after the egg is discharged, or possibly in some cases before, since in many specimens the medusæ are never liberated, and the eggs seem to be discharged with difficulty and not infrequently exhibit segmentation phases while yet within the bell of the medusa. But so far as I have been able to note, the sperms always gain access to the egg from the outside.

The extrusion of the polar globules is only rarely to be noted, but occurs in an altogether normal way. Segmentation begins usually within fifteen minutes of the access of the spermatozoon. The first cleavage is usually into fairly normal two-celled forms, but seldom exactly in the same way, perhaps no two eggs exhibiting the same cleavage features. This is peculiarly the case in all the later phases. It is absolutely indeterminate and remarkably irregular and erratic. So much so was this that during the first series of observations the whole lot were discarded, as probably for some unknown reason abnormal or pathological. A second series taken the next night behaved in the same way, and while still thought to be somewhat abnormal were followed through to the completion of the irregular cleavage, and were found the following morning to have become perfectly normal planulæ.

That they were genuine cleavage phenomena was conclusively proved by sections of the various stages and the demonstration of mitotic figures in all phases of growth and decline.

Somewhat similar though incomparably less marked phenomena had been noted long ago by Wilson in the development of *Renilla*, and by Metschnikoff in *Rathkea* and